

### § 23.369

data applicable to the particular engine-propeller combination.

(4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine-propeller-airplane combination.

(b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than 2 seconds after the engine failure. The magnitude of the corrective action may be based on the limit pilot forces specified in § 23.397 except that lower forces may be assumed where it is shown by analysis or test that these forces can control the yaw and roll resulting from the prescribed engine failure conditions.

[Amdt. 23-7, 34 FR 13089, Aug. 13, 1969]

### § 23.369 Rear lift truss.

(a) If a rear lift truss is used, it must be designed to withstand conditions of reversed airflow at a design speed of—

$V = 8.7 \sqrt{(W/S)} + 8.7$  (knots), where  $W/S$  = wing loading at design maximum takeoff weight.

(b) Either aerodynamic data for the particular wing section used, or a value of  $C_L$  equalling  $-0.8$  with a chordwise distribution that is triangular between a peak at the trailing edge and zero at the leading edge, must be used.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13089, Aug. 13, 1969; 34 FR 17509, Oct. 30, 1969; Amdt. 23-45, 58 FR 42160, Aug. 6, 1993; Amdt. 23-48, 61 FR 5145, Feb. 9, 1996]

### § 23.371 Gyroscopic and aerodynamic loads.

(a) Each engine mount and its supporting structure must be designed for the gyroscopic, inertial, and aerodynamic loads that result, with the engine(s) and propeller(s), if applicable, at maximum continuous r.p.m., under either:

(1) The conditions prescribed in § 23.351 and § 23.423; or

(2) All possible combinations of the following—

(i) A yaw velocity of 2.5 radians per second;

(ii) A pitch velocity of 1.0 radian per second;

(iii) A normal load factor of 2.5; and

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(iv) Maximum continuous thrust.

(b) For airplanes approved for aerobatic maneuvers, each engine mount and its supporting structure must meet the requirements of paragraph (a) of this section and be designed to withstand the load factors expected during combined maximum yaw and pitch velocities.

(c) For airplanes certificated in the commuter category, each engine mount and its supporting structure must meet the requirements of paragraph (a) of this section and the gust conditions specified in § 23.341 of this part.

[Doc. No. 27805, 61 FR 5145, Feb. 9, 1996]

### § 23.373 Speed control devices.

If speed control devices (such as spoilers and drag flaps) are incorporated for use in enroute conditions—

(a) The airplane must be designed for the symmetrical maneuvers and gusts prescribed in §§ 23.333, 23.337, and 23.341, and the yawing maneuvers and lateral gusts in §§ 23.441 and 23.443, with the device extended at speeds up to the placard device extended speed; and

(b) If the device has automatic operating or load limiting features, the airplane must be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section at the speeds and corresponding device positions that the mechanism allows.

[Amdt. 23-7, 34 FR 13089, Aug. 13, 1969]

### CONTROL SURFACE AND SYSTEM LOADS

### § 23.391 Control surface loads.

The control surface loads specified in §§ 23.397 through 23.459 are assumed to occur in the conditions described in §§ 23.331 through 23.351.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-48, 61 FR 5145, Feb. 9, 1996]

### § 23.393 Loads parallel to hinge line.

(a) Control surfaces and supporting hinge brackets must be designed to withstand inertial loads acting parallel to the hinge line.

(b) In the absence of more rational data, the inertial loads may be assumed to be equal to  $KW$ , where—

(1)  $K = 24$  for vertical surfaces;

- (2)  $K = 12$  for horizontal surfaces; and  
 (3)  $W$  = weight of the movable surfaces.

[Doc. No. 27805, 61 FR 5145, Feb. 9, 1996]

#### § 23.395 Control system loads.

(a) Each flight control system and its supporting structure must be designed for loads corresponding to at least 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in §§ 23.391 through 23.459. In addition, the following apply:

(1) The system limit loads need not exceed the higher of the loads that can be produced by the pilot and automatic devices operating the controls. However, autopilot forces need not be added to pilot forces. The system must be designed for the maximum effort of the pilot or autopilot, whichever is higher. In addition, if the pilot and the autopilot act in opposition, the part of the system between them may be designed for the maximum effort of the one that imposes the lesser load. Pilot forces used for design need not exceed the maximum forces prescribed in § 23.397(b).

(2) The design must, in any case, provide a rugged system for service use, considering jamming, ground gusts, taxiing downwind, control inertia, and friction. Compliance with this subparagraph may be shown by designing for loads resulting from application of the minimum forces prescribed in § 23.397(b).

(b) A 125 percent factor on computed hinge moments must be used to design elevator, aileron, and rudder systems. However, a factor as low as 1.0 may be used if hinge moments are based on accurate flight test data, the exact reduction depending upon the accuracy and reliability of the data.

(c) Pilot forces used for design are assumed to act at the appropriate control grips or pads as they would in flight, and to react at the attachments of the control system to the control surface horns.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13089, Aug. 13, 1969]

#### § 23.397 Limit control forces and torques.

(a) In the control surface flight loading condition, the airloads on movable surfaces and the corresponding deflections need not exceed those that would result in flight from the application of any pilot force within the ranges specified in paragraph (b) of this section. In applying this criterion, the effects of control system boost and servo-mechanisms, and the effects of tabs must be considered. The automatic pilot effort must be used for design if it alone can produce higher control surface loads than the human pilot.

(b) The limit pilot forces and torques are as follows:

Control	Maximum forces or torques for design weight, weight equal to or less than 5,000 pounds <sup>1</sup>	Minimum forces or torques <sup>2</sup>
Aileron:		
Stick .....	67 lbs .....	40 lbs.
Wheel <sup>3</sup> .....	50 D in.-lbs. <sup>4</sup> .....	40 D in.-lbs. <sup>4</sup>
Elevator:		
Stick .....	167 lbs .....	100 lbs.
Wheel (symmetrical) .....	200 lbs .....	100 lbs.
Wheel (unsymmetrical) <sup>5</sup> .....	.....	100 lbs.
Rudder .....	200 lbs .....	150 lbs.

<sup>1</sup>For design weight ( $W$ ) more than 5,000 pounds, the specified maximum values must be increased linearly with weight to 1.18 times the specified values at a design weight of 12,500 pounds and for commuter category airplanes, the specified values must be increased linearly with weight to 1.35 times the specified values at a design weight of 19,000 pounds.

<sup>2</sup>If the design of any individual set of control systems or surfaces makes these specified minimum forces or torques inapplicable, values corresponding to the present hinge moments obtained under § 23.415, but not less than 0.6 of the specified minimum forces or torques, may be used.

<sup>3</sup>The critical parts of the aileron control system must also be designed for a single tangential force with a limit value of 1.25 times the couple force determined from the above criteria.

<sup>4</sup>D=wheel diameter (inches).

<sup>5</sup>The unsymmetrical force must be applied at one of the normal handgrip points on the control wheel.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13089, Aug. 13, 1969; Amdt. 23-17, 41 FR 55464, Dec. 20, 1976; Amdt. 23-34, 52 FR 1829, Jan. 15, 1987; Amdt. 23-45, 58 FR 42160, Aug. 6, 1993]

#### § 23.399 Dual control system.

(a) Each dual control system must be designed to withstand the force of the pilots operating in opposition, using individual pilot forces not less than the greater of—

- (1) 0.75 times those obtained under § 23.395; or